

# इंटरनेट

# मानक

## Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 10329 (1982): Method for sensitometry of photographic papers [CHD 5: Electroplating Chemicals and Photographic Materials]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



BLANK PAGE



IS : 10329 - 1982

*Indian Standard*  
METHOD FOR  
SENSITOMETRY OF PHOTOGRAPHIC PAPERS

UDC 771.531.2 : 771.534.5



© Copyright 1983

**INDIAN STANDARDS INSTITUTION**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

# Indian Standard

## METHOD FOR SENSITOMETRY OF PHOTOGRAPHIC PAPERS

Photographic Materials Sectional Committee, CDC 44

### Chairman

### Representing

SHRI B. V. RAMACHANDRA

India Photographic Co Ltd, Bombay

### Members

SHRI RAMESH I. BHAT	Colorama Studio, Bombay
SHRI DHIRAJ D. VYAS ( Alternate )	
SHRI P. T. BHOPALE	Agfa-Gevaert India Ltd, Bombay
SHRI R. S. PATWA ( Alternate )	
SHRI K. V. DAMODARAN	Satyadev Chemicals Pvt Ltd, Vadodara
DR GEORGE KURIAN ( Alternate )	
COL D. M. GUPTA	Survey of India, Dehra Dun
MAJ M. K. MUNSHI ( Alternate )	
SHRI B. N. KONDA REDDI	Vijaya Productions Pvt Ltd, Madras
SHRI V. DINAKARA REDDI ( Alternate )	
SHRI T. J. LALKA	Jay Photographic Papers, Bombay
SHRI J. C. MAKANI	Ministry of Defence ( DGI )
SHRI G. S. SHUKLA ( Alternate )	
SHRI Y. D. MATHUR	The New India Industries Ltd, Bombay
SHRI K. S. NAGARAJAN	Indian National Scientific Documentation Centre ( CSIR ), New Delhi
SHRI T. SURYANARAYAN ( Alternate )	
SHRI S. K. PATEL	Liberty Chemicals Works, Bombay
SHRI V. N. KAMAT ( Alternate I )	
SHRI P. M. NAGARKAR ( Alternate II )	
SHRI K. R. PRABHAKAR	Armed Forces Film & Photo Division ( Ministry of Defence ), New Delhi
SHRI T. R. RAMASASTRY	Hindustan Photo Films Mfg Co Ltd, Ootacamund
SHRI V. K. RAJAGOPALAN NAIR ( Alternate )	
SHRI P. RAMASWAMY	Gemini Colour Laboratory, Madras
SHRI S. RAJENDER ( Alternate )	
SHRI D. C. SHAH	The Kesar Sugar Works Ltd, Bombay
SHRI K. RAMANKUTTY ( Alternate )	
SHRI P. P. SHARMA	Directorate General of Technical Development, New Delhi
SHRI N. K. AGARWAL ( Alternate )	

( Continued on page 2 )

© Copyright 1983

INDIAN STANDARDS INSTITUTION

This publication is protected under the *Indian Copyright Act* ( XIV of 1957 ) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act

( Continued from page 1 )

<i>Members</i>	<i>Representing</i>
SHRI K. C. SHETH	Film Centre ( Ministry of Information and Broadcasting ), Bombay
SHRI M. M. VAIDYA	Films Division, Bombay
SHRI I. B. JHANGIANI ( <i>Alternate</i> )	
SHRI B. K. VISWANATH	The Bombay Film Laboratories Pvt Ltd, Bombay
SHRI S. K. MATHUR,	Director General, ISI ( <i>Ex-officio Member</i> )
Head ( Chem ) ( <i>Secretary</i> )	

### Photographic Sensitized Materials Subcommittee, CDC 44 : 4

<i>Convener</i>	
SHRI T. J. LALKA	Jay Photographic Papers, Bombay
<i>Members</i>	
SHRI A. R. BHATE	Famous Cine Laboratories & Studios Ltd, Bombay
SHRI V. N. BHATNAGAR	Gramophone Co of India Ltd, Calcutta
SHRI P. T. BHOPALE	Agfa-Gevaert India Ltd, Bombay
SHRI R. S. PATWA ( <i>Alternate</i> )	
SHRI B. N. KONDAREDDI	Vijaya Productions Pvt Ltd, Madras
SHRI V. DINAKARA REDDI ( <i>Alternate</i> )	
SHRI Y. D. MATHUR	The New India Industries Ltd, Bombay
SHRI PADMAKAR GANESH MULAY	The Bombay Film Laboratories Pvt Ltd, Bombay
SHRI B. K. VISHWANATH ( <i>Alternate</i> )	
SHRI P. J. PATEL	ORWO Pvt Ltd, Bombay
SHRI T. R. RAMASASTRY	Hindustan Photo Films Mfg Co Ltd, Ootacamund
SHRI V. K. RAJAGOPALAN NAIR ( <i>Alternate</i> )	
SHRI PALANIAPPAN RAMASWAMY	Gemini Colour Laboratory, Madras
SHRI R. RAMAMURTHY ( <i>Alternate I</i> )	
SHRI D. RAMAMURTHY ( <i>Alternate II</i> )	
DR SHANTILAL C. SHAH	Indian Radiological Association, New Delhi
PROF O. P. BHARDWAJ ( <i>Alternate</i> )	
SHRI M. M. VAIDYA	Films Division, Bombay
SHRI I. B. JHANGIANI ( <i>Alternate</i> )	

# *Indian Standard*

## METHOD FOR SENSITOMETRY OF PHOTOGRAPHIC PAPERS

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 29 October 1982, after the draft finalized by the Photographic Materials Sectional Committee had been approved by the Chemical Division Council.

**0.2** In the preparation of this standard considerable assistance has been derived from ASA.PH-2.2-1966 'Sensitometry of Photographic Papers' issued by the American Standards Association.

**0.3** In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960\*.

---

### 1. SCOPE

**1.1** This standard prescribes a method of determining certain sensitometric characteristics of developing-out black-and-white photographic papers intended for contact or projection printing of photographic negatives. It specifies the exposing and processing conditions to be used in determining the density-*versus*-log-exposure curve of the photographic papers. It also specifies procedures for deriving numerical values for such significant sensitometric characteristics as speed, maximum shoulder density, density range, and log exposure range.

### 2. EXPOSING AND PROCESSING

**2.1 Conditioning the Sample Before Testing** — The test sample shall be in equilibrium with an atmosphere maintained at a temperature of  $20 \pm 5^{\circ}\text{C}$  and a relative humidity of  $55 \pm 10$  percent.

---

\*Rules for rounding off numerical values (*revised*).

## 2.2 Exposing the Sample

**2.2.1 Type of Sensitometer** — The sensitometer shall be a nonintermittent intensity-scale type.

**2.2.2 Exposure Time** — The time of exposure shall be within the range of 0.1 to 10 seconds.

**2.2.3 Modulation** — The spectral transmission density of the light modulator ( that is grey scale ) shall not differ by more than 0.06 for any two wavelengths within the wavelength range of 350 to 700 millimicrons.

**2.2.3.1** For continuous modulation of the exposure along the sensitometric test strip, the exposure ratio shall not be greater than 2 per cm and shall be uniform along the strip. If stepped increments are used, the minimum exposure increment shall be a factor of the square root of 2 per step, and each step shall have a minimum width of 0.8 cm.

**2.2.4 Quality of Radiant Energy Incident on the Sample** — The spectral energy distribution of the modulated radiant energy on the sample shall be equal to that of a blackbody radiator at a temperature of  $3\,000 \pm 25^\circ\text{K}$ . This distribution may be very closely approximated by means of a tungsten-filament lamp operated at a colour temperature of  $3\,000 \pm 25^\circ\text{K}$  or, in the interest of longer lamp life, by means of a tungsten-filament lamp operated at a colour temperature of  $2\,850^\circ\text{K}$  in combination with a suitable filter for converting the spectral energy distribution approximately to that of a blackbody radiator at  $3\,000 \pm 25^\circ\text{K}$ .

**2.2.5 Tolerance of Exposure** — The product of illuminance and time ( I.t = exposure ) shall be expressed in absolute photometric units and shall be maintained within  $\pm 5$  percent of the intended values, or approximately  $\pm 0.02$  log units.

**2.3 Processing the Sample** — The test sample shall be processed as soon as possible after exposure to avoid possible change of latent image. The time lapse between exposure and development shall not exceed 2 hours, and the exposed sample shall be stored at a temperature of  $20 \pm 5^\circ\text{C}$  and a relative humidity of  $55 \pm 10$  percent.

### 2.3.1 Developing Solution

Distilled water, about $50^\circ\text{C}$ ( see IS : 1070-1977* )	500 ml
Mono-methyl-para-amino- phehol sulphate ( see IS : 4173-1974† )	3.1 g

\*Specification for water for general laboratory use ( second revision ).

†Specification for 4-methylaminophenol sulphate ( first revision ).



Sodium sulphite, anhydrous ( <i>see</i> IS : 247-1972* )	45.0 g
Hydroquinone ( <i>see</i> IS : 388-1972† )	12.0 g
Sodium carbonate, mono-hydrate ( or Sodium carbonate anhydrous 68.0 g )	80.0 g
Potassium bromide ( <i>see</i> IS : 2797-1964‡ )	1.9 g
Distilled water to make	1 000 ml

**2.3.1.1** The solution shall be stored for 24 to 48 hours in a tightly stoppered amber coloured glass bottle with minimum air gap at the top.

**2.3.2** One part of solution shall be freshly diluted with 2 parts of distilled water and used at a temperature of  $20 \pm 0.5^{\circ}\text{C}$  for developing each test.

**2.3.3 Developing Technique** — Development shall be carried out in a horizontal 300 mm  $\times$  350 mm tray containing 2 litres of developer. During development the sensitometrically exposed samples shall be held in a plane close and parallel to the bottom of the tray by means of any device that shall not interfere physically or chemically with the exposed area to such an extent as to influence the final sensitometric result. Five of the 35 mm  $\times$  250 mm sensitometric strips fastened to a 200 mm  $\times$  250 mm glass plate may be conveniently handled in this manner.

**2.3.4** The developer shall be agitated during development to an extent equivalent to that provided by rocking the tray at a rate of  $7\frac{1}{2}$  complete cycles per minute. A cycle shall be one motion in each of the four directions. Such agitation or rocking of the tray may be facilitated by using a block 65 mm  $\times$  50 mm  $\times$  20 mm under the tray centre with the block side parallel to the tray sides.

**2.3.5** Other techniques of development may be employed as agreed to between the purchaser and the supplier.

**2.3.6 Time of Development** — The development time shall be  $1\frac{1}{2}$  minutes or the development time shall be as specified by the manufacturer.

**2.3.7 Stop Bath** — At the completion of development, the samples shall be transferred immediately to the following solution at a temperature of  $20 \pm 5^{\circ}\text{C}$  for 15 seconds:

Acetic acid, 28 percent	45 ml
Distilled water	1 000 ml

---

\*Specification for sodium sulphite, anhydrous ( *third revision* ).

†Specification for hydroquinone, photographic grade ( *third revision* ).

‡Specification for potassium bromide.

**2.3.8 Fixing** — The samples shall then be transferred to the following solution at a temperature of  $20 \pm 5^\circ\text{C}$  for 5 minutes, with agitation for 30 seconds. The solution shall be seasoned by fixing out for 10 minutes 4 square metre of unprocessed photographic paper per litre of solution:

Distilled water at $50^\circ\text{C}$	600 ml
Sodium thiosulphate, crystalline ( <i>see</i> IS : 246-1972* )	240 g
Sodium sulphite, anhydrous ( <i>see</i> IS : 247-1972† )	10 g
Sodium metabisulphite ( <i>see</i> IS : 248-1978‡ )	25 g

**2.3.9 Washing** — The samples shall be washed in running water at a temperature of  $20 \pm 5^\circ\text{C}$  for 15 minutes or washed in six changes of water with 5 minutes between each change. These conditions of washing may be used for sensitometric purposes only and may not imply permanence of the print.

**2.3.10 Drying** — All samples shall be air-dried in an atmosphere maintained within the limits of  $25 \pm 10^\circ\text{C}$  and a relative humidity of  $55 \pm 10$  percent.

### 3. CONSTRUCTING THE $D \log E$ CURVE

**3.1 Plotting the Curve** — The optical density of the sensitometric steps shall be measured using a suitable reflectance densitometer. The reflection densities ( $D_r$ ) as ordinates shall be plotted against their corresponding log exposure ( $\log E$ ) values as abscissas, and a smooth curve shall be drawn through the plotted points,  $E$  shall be expressed in metre-candle-seconds ( *see* Fig. 1 ). The scale units on the graph paper for the abscissa and the ordinate shall have equal spacing. For brevity, the reflection density will be referred to as density and the symbol  $D$  used without the subscript  $r$  in this standard.

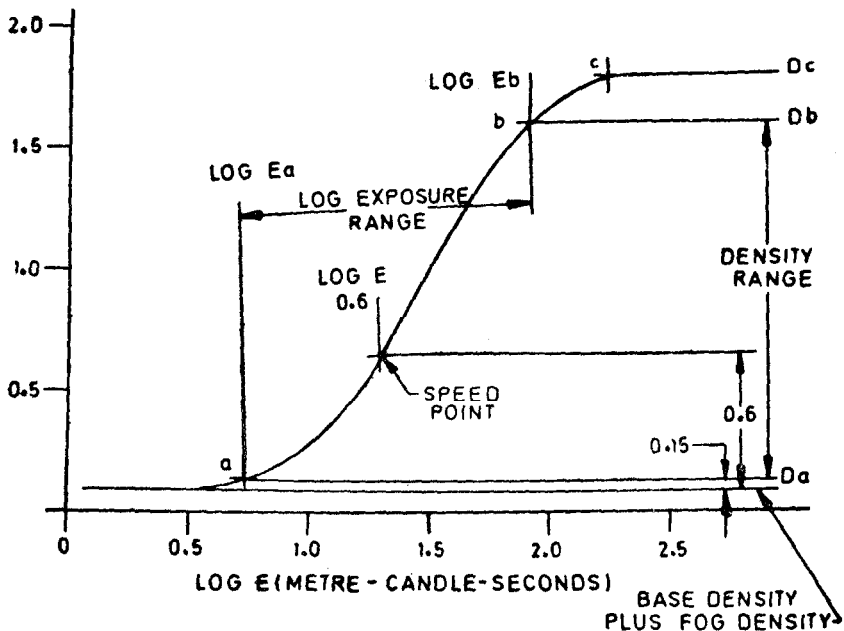
### 4. DERIVING SENSITOMETRIC CHARACTERISTICS

**4.1 Locating Points on the  $D \log E$  Curve** — The characteristics shall be for the development time given in 2.3.3. The specified sensitometric characteristics shall be derived from the coordinates of two points,  $a$  and  $b$ , found on the  $D \log E$  curve ( Fig. 1 ) in the high-light and shadow regions, respectively. The point  $a$  is located on the toe of the  $D \log E$  curve where the density is 0.15 above the sum of the base density and the fog density ( *see* 4.5 ). The point  $b$  is located on the shoulder of the curve at 0.9 of the maximum shoulder density,  $D_c$  ( *see* 4.4 ).

\*Specification for sodium thiosulphate, crystalline ( *third revision* ).

†Specification for sodium sulphite, anhydrous ( *third revision* ).

‡Specification for sodium bisulphite ( sodium metabisulphite ) ( *third revision* ).

FIG. 1  $D \text{ LOG } E$  CURVE

**4.2 Log Exposure Range** — The difference between the abscissa values for the limiting points  $b$  and  $a$  shall be called log exposure range.

$$\text{Log Exposure Range} = \log E_b - \log E_a$$

**4.3 Density Range** — The difference between the ordinate values, expressed as in 4.2, for the limiting points  $b$  and  $a$  shall be called density range.

$$\text{Density Range} = D_b - D_a$$

**4.4 Maximum Shoulder Density** — The ordinate value for the point  $c$  shall be called maximum shoulder density and shall be designated as  $D_c$ . Point  $c$  is the point on the shoulder of the curve where the gradient has diminished to 0.05. Usually, the greatest density reached by the curve approximates this value.

**4.5 Fog Density** — Fog density shall be the reflection density difference between an unexposed, processed test sample, which gives the sum of the base density and the fog density, and an unexposed, fixed-out

test sample, which gives the base density of the same material. Processing shall be as specified in 2.3.

**4.6 Speed** — The speed of a photographic material shall be a numerical expression of its sensitivity to light for conditions of exposure and development that conform to normal use.

**4.6.1** The absolute accuracy of the testing procedure as specified under 2.2 and 2.3 shall be such that the systematic error in the logarithm to the base 10 of the exposure value for determining speed shall be not greater than  $\pm 0.05$ .

**4.6.2 Paper Speed** — Speed determined by the method of this standard and computed by the following formula shall be identified as paper speed,  $S$ .

$$S = \frac{10^8}{E_{0.6}}$$

where  $E_{0.6}$  is the exposure in metre-candle-seconds required to obtain a density of 0.6 above the base plus fog density.

## 5. SENSITOMETRIC CHARACTERISTICS OF A PRODUCT

**5.1 Product Characteristics** — The characteristics of a product as distinguished from those of a specific sample shall be based on the numerical average of the values obtained for at least 12 samples of the product.